BIOMEDICAL ENGINEERING

Biomedical engineers use science, engineering, and mathematics to understand and solve medical problems. We focus on improving people's quality of life. Biomedical engineers who specialize in biomechanics design and analyze biological systems or medical devices that have to do with forces, stresses, and strains. This includes studying the motions of bodies or joints, fluid flow, the deformation of tissues or materials, and the transport of molecules and chemicals through tissues and across membranes.

Biomedical engineers who specialize in bioinstrumentation use electronics and signal analysis to take measurements from and deliver stimuli to living cells and tissues. Examples include cochlear implants, pacemakers, and patient monitoring equipment. Biomedical engineers who specialize in biomaterials design and study materials to replace, repair, and interact with cells and tissues in the body. Examples include metal, ceramic, polymer, or tissue-engineered implants; these implants can be permanent or biodegradable. The United States Bureau of Labor Statistics projects employment of bioengineers and biomedical engineers to grow 7 percent from 2023 to 2033, faster than the average for all occupations.

The biomedical engineering program at Rose-Hulman produces engineers with the medical and biological expertise needed to solve health care problems during careers in technical and health-related industries, as well as in government or industrial laboratories. Alumni wishing to continue their studies in graduate/professional school or health professions programs will be well-qualified to do so.

Requirements

The Advanced Individualized Mission

The Advanced Individualized Mission (AIM) provides a mechanism for students to customize advanced coursework to correspond with career goals defined by the student. Plans of study for a student's AIM must be reviewed by a committee of departmental faculty as part of BE 238 Regulatory Affairs & Product Design. A final deliverable for the AIM is due as part of BE 438 Engineering Portfolio Development. Alterations to the AIM plan of study must be approved by the faculty committee.

The AIM plan of study must:

1. Comprise of 24 credits
2. Have a clearly identified theme,
3. Include a biomedical engineering component or application,
4. Include a minimum of 12 credits at 400 level or above, at least 8 of which must be engineering credits.
5. Not include any named required courses

Plan of Study

Below is a sample plan of study that illustrates one way to achieve the program requirements. Any given student's plan of study may differ based on a variety of factors (e.g., advanced credit, placement exams, adding a minor). Enrolled students will work with their academic advisor; utilize the degree audit/planner to create a specific plan of study.

Course	Title	Hours
Freshman		
Fall		
BE 100	Problem Solving in the Biological Sciences & Engineering	4
BE 118	Design Thinking and Communication	2
MA 111	Calculus I	5
RHIT 100	Foundations for Rose-Hulman Success	1
HUM H190	First-Year Writing Seminar	4
	Hours	**16**
Winter		
BE 121	DC Circuits	2
BE 122	Systems Accounting and Modeling I	3
BE 128	Design Thinking & Realization	3
MA 112	Calculus II	5
PH 111	Physics I	4
PH 111L	Physics I Lab	0
	Hours	**17**
Spring		
BE 131	AC Circuits	2
BE 132	Systems Accounting and Modeling II	3
BE 138	Design Thinking and Human-Centered Products	3
MA 113	Calculus III	5
PH 112	Physics II	4
PH 112L	Physics II Lab	0
	Hours	**17**
Sophomore		
Fall		
BE 211	Circuits, Sensors, and Measurements	3
BE 218	Design Methodologies	3
MA 221	Matrix Algebra & Differential Equations I	4
CHEM 111	General Chemistry I	3
CHEM 111L	General Chemistry I Lab	1
	Hours	**14**
Winter		
BE 222	Mechanics of Materials	4
BE 228	Design Leadership & Teamwork	2
MA 222	Matrix Algebra & Differential Equations II	4
CHEM 113	General Chemistry II	3
CHEM 113L	General Chemistry II Laboratory	1
BIO 110	Cell Structure and Function	4
	Hours	**18**
Spring		
BE 232	Biomechanics	3
BE 233	Biomaterials	3
BE 238	Regulatory Affairs & Product Design	4
MA 223	Engineering Statistics	4
ENGL H290	Technical & Professional Communication	4
	Hours	**18**
Junior		
Fall		
BE 314	Musculoskeletal Systems Physiology with Applications	4
BE 315	Biomedical Engineering Lab I	2
BE 318	Medical Device Research & Design	3
BIO 130	Evolution & Diversity	4
HSSA Elective		4
	Hours	**17**
Winter		
BE 321	Biosignal Processing	4
BE 324	Neural and Endocrine Systems Physiology with Applications	4

BE 328	Capstone Design I: Designing Products for the Real World	4
HSSA Elective		4
	Hours	**16**
Spring		
BE 334	Cardiovascular, Respiratory, and Renal Systems Physiology with Applications	4
BE 335	Biomedical Engineering Lab II	2
BE 338	Capstone Design II: Product Design & Prototyping	4
AIM Elective		4
HSSA Elective		4
	Hours	**18**
Senior		
Fall		
BE 418	Capstone Design III: Product Verification and Validation	4
AIM Elective		4
AIM Elective		4
HSSA Elective		4
	Hours	**16**
Winter		
BE 428	Capstone Design IV: Integrated Product Design & Practice	2
AIM Elective		4
AIM Elective		4
HSSA Elective		4
	Hours	**14**
Spring		
BE 438	Engineering Portfolio Development	2
AIM Elective		4
HSSA Elective		4
HSSA Elective		4
	Hours	**14**
	Total Hours	**195**

Biomedical Engineering Thesis Option

The biomedical engineering thesis option is intended for students who complete a substantive research project in this field. In order to complete this thesis option a student must:

1. Pass a minimum of 8 credit hours of BE 492 Directed Study in Biomedical Engineering.
2. Perform research in BE 492 Directed Study in Biomedical Engineering that involves the same research project and is completed under the direction of a departmental faculty mentor. None of these credits may be used to fulfill the biomedical engineering area elective requirement.
3. Complete the course, BE 499 Thesis Research, in which the thesis is written and submitted to the department, and an oral research presentation is given to a minimum of three departmental faculty members, including the student's advisor. Successful completion of the biomedical engineering thesis will be noted on the student's transcript.

Program Objectives

Biomedical Engineering Program Educational Objectives

Objectives are defined as "expected accomplishments of graduates during the first several years following graduation from the program."

- Alumni will be applying the knowledge and/or habits of mind gained from their study of biology, physiology, mathematics, physical science, and engineering, in a fulfilling and productive manner.
- Alumni will be working and communicating effectively with all of the people around them.
- Alumni will be serving society, through their professional and/or personal activities.
- Alumni will be solving open-ended problems, drawing from their experiences in using design principles subject to constraints.

Learning Outcomes

Biomedical Engineering Student Outcomes

By the time students graduate with an undergraduate Biomedical Engineering degree from Rose-Hulman, they will have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The biomedical engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission's General Criteria and Program Criteria for Bioengineering and Biomedical and Similarly Named Engineering Programs.